

Efficacy and safety of the inject and cut technique for endoscopic colonic polypectomy

William Otero R., MD,¹ Alejandro Concha M., MD,² Martín Gómez Z., MD.³

¹ Professor of Medicine in the Gastroenterology Unit at the Universidad Nacional de Colombia, Gastroenterologist at the Clínica Fundadores of the Hospital Fundación San Carlos
² Gastroenterologist at the Hospital San Ignacio
³ Professor of Medicine in the Gastroenterology Unit at the Universidad Nacional de Colombia, Gastroenterologist at the Hospital El Tunal

Received: 03-10-12
Accepted: 17-01-13

Abstract

Colonic polypectomy is the most important tool for stopping adenoma-cancer, and the inject and cut technique has demonstrated efficacy and safety in studies conducted in other countries. Since in our country there are no reported data on performance of this technique, it is necessary to describe the experience of a gastroenterology unit of a university. **Objectives:** The objectives of this study were to describe operational characteristics of endoscopic colonic polypectomy using the inject and cut technique and to describe demographic characteristics of patients undergoing this procedure. **Materials and Methods:** We included all patients who underwent endoscopic colonic polypectomies in the gastroenterology unit of the Clínica Fundadores in Bogotá from January 2003 to September 2011. Data were processed using SPSS version 18.8 (SPSS-IBM) statistical package. **Results:** 420 patients underwent polypectomies which resected a total of 548 polyps. Mean patient age was 56.3 years (range 14 to 93), 201 patients were male, and 219 were female. Polyps were most commonly located in the left colon (238/64.4%). Average size was 1.6 cm. 83.8% were pedunculated, 13.3% were sessile, and 2.85% were flat. Intraoperative bleeding occurred in 36 cases (8.6%). There was no relationship between this complication and the size of polyps (≤ 20 vs > 20 mm), OR: 0.44 (CI 0.19-1.01), nor with the number of resected polyps (1 vs > 1) OR: 1.44, (95%: 0.65-3.2). All cases of bleeding were controlled endoscopically without further complications. There was no need for surgery. There were no local recurrences during follow-up. **Conclusions:** This study showed that the inject and cut technique is a practical, effective, economical and easy to perform technique for removal of colonic polyps. To date this is the largest series published in our country on the subject.

Keywords

Polypectomy, inject, cut, efficacy, safety.

INTRODUCTION

Extensive use of colonoscopy either as a diagnostic or screening tool has increased detection of colonic polyps and colon cancers at early stages (1). The removal of colon polyps (CP) has been shown to decrease the incidence of colon cancer (CC) and is also a therapeutic modality for early colon cancer (1, 2). Currently, CPs are often treated endoscopically (1, 3-5). Therapeutic challenges include large sessile polyps with diameters of more than 2cm and heights of more than 2.5 mm and flat polyps less than 2.5 mm high (6). These types frequently exhibit high-grade dysplasia, malignancies, adenocarcinoma (2, 3) and high

rates of complications. Complications which can occur during resection include hemorrhaging and perforations while postpolypectomy syndrome occurs afterwards (4). There are two techniques for endoscopic treatment of colon polyps: endoscopic mucosal resection (mucosectomy) and endoscopic submucosal dissection (ESD) (4). The latter has been developed to achieve en bloc resection of large lesions of the upper gastrointestinal tract (7) and has been used more and more frequently for resection of large colonic, flat or sessile polyps in the distal colon (8-10). It has efficiently replaced standard mucosectomy for complete eradication of these lesions and complies with the main goal of endoscopic treatment of breaking the

adenoma-cancer sequence (12-15). Endoscopic resection using the submucosal injection technique to separate the muscle has become the standard technique for resecting large colonic polyps (16) since, like ESD, it can achieve complete resection of most lesions if appropriate quality standards are followed (12, 17-19). With the *inject and cut* technique, resection of most lesions is accomplished *in toto* which allows for histologic evaluation that can accurately determine whether resection was complete and did not leave any residual adenomatous tissue that could cause recurrence of adenomas. Malignancy remains a risk when there is residual adenoma (18, 20).

Advanced adenomas (larger than a centimeter with villous histologic features or high-grade dysplasia) pose the greatest risks of becoming cancer (21-24). The most important issue related to polyps is their recognized relationship with CC (18-20). Currently it is accepted that 95% of CCs originate in adenomatous polyps (1-3).

Colonic polypectomy is the most important tool for stopping the adenoma-cancer sequence as clearly demonstrated in population studies. The management of polyps with standard polypectomy techniques has revealed deficiencies in its main objective of breaking the adenoma-cancer sequence. Strictly speaking, performing a colonic polypectomy using the *inject and cut* technique is an endoscopic mucosal resection when performed according to appropriate quality standards (24) since after separating the muscularis submucosa, the lesion in the mucosa is resected (13, 24, 26). The ultimate benefit of this technique is to allow complete resection of the lesion which is essential to reduction of recurrence of adenomas as well as to healing of early tumors (13, 26, 27).

Although studies in other countries (25, 26) have shown that this technique is effective and safe, a review of Colombian literature found no studies describing experience performing colonic polypectomies using the *inject and cut* technique. Given this lack of studies on this subject in our Colombia, the high prevalence of colon cancer here, the fact that it is the fourth leading cause of cancer death in both sexes in this country (28), we decided to conduct this study to report the experience of a university center with a large series of patients.

The overall objectives of this research are to describe the characteristics of cases in which colon endoscopic polypectomy was conducted through the *inject and cut* technique and to describe the operational characteristics of this method.

The specific objectives of this study are to describe demographic characteristics in terms of gender and age of the patients who underwent colonoscopic polypectomies, to describe the pathological features of resected polyps, and to evaluate the efficacy, safety and clinical outcomes of this technique.

MATERIALS AND METHODS

Patients

We included all patients who underwent endoscopic polypectomy for sessile, flat or pedunculated colonic polyps greater than or equal to 10 mm in the gastroenterology and endoscopy unit of Clinica Fundadores in Bogota, Colombia from January 2003 to September 2011. Patients were included only when we had the exact description of the procedure and pathology results. 2-4 mm polyps were resected with biopsy forceps provided they could be completely "embraced." Larger polyps which were still less than 10 mm were resected with a snare but without use of an electrosurgery unit (cold snare) (9, 10). These small polyps represent 90% of the polyps found in daily practice (29, 30, 31). As part of the treatment protocol in the gastroenterology unit, the patient signed an informed consent form for the therapeutic procedure. Sedation was always administered by an anesthesiologist and always required that the patient sign an additional informed consent form for sedation.

At the institution where the study was performed prothrombin time, partial thromboplastin time and CBC were measured for all patients before scheduling the procedure in accordance with the protocol. Patients receiving anticoagulants or anti-platelet therapy were advised to discontinue such drugs for at least a week before the procedure was due to be performed. When there was any doubt about the need for such drugs, patients were referred to internal medicine or cardiology for approval of gastroenterology recommendations or for a change of anticoagulation scheme or other treatment modification. Cleaning of the colon, similar to that for diagnostic colonoscopies, used oral sodium phosphate solution (Travad oral[®] 133 ml) or a polyethylene glycol solution with electrolytes (Nulytely[®], Tecnofarma or Klean Prep[®], Biotoscana). The first was given to patients under 60 years of age without cardiovascular comorbidities, renal failure, or diabetes mellitus. Polyethylene glycol was given to patients over 60 or to those who had any of the medical conditions mentioned. Preparations began the day before the procedure with normal diet until lunch followed by a liquid diet. If oral Travad was chosen, the patient drank a container of it at 5 pm followed by five to seven cups of liquid (water or juice). Two hours later the patient repeated this procedure. If polyethylene glycol was chosen, the patient drank a glass of a solution of two envelopes diluted in one liter of water each every 15 minutes until all two liters had been consumed (over two hours). Two additional envelopes were ingested following the same pattern three hours before the procedure. If the procedure was performed under sedation,

the patient consumed all four envelopes the day before the procedure and fasted until the procedure.

Polypectomy

All polypectomies were performed by one of the authors (WO). OLYMPUS EXERA CV 160 video imaging equipment was used. Submucosal injection was performed from a colonoscope with Olympus NM-400U-0425 disposable injection needles. To achieve proper elevation of the submucosa the needle was inserted into the colon wall at a 30 degree (or less) angle. The solution was injected immediately after the needle passed through the mucosa. When elevation of the mucosa could not be achieved, the needle was moved deeply into the mucosa and then slowly removed while the assistant injected solution through the catheter (16, 35). Saline solution 0.9 N was used to separate the mucosa. The injection volume varied between 5ml and 20 ml depending on the size of the polyp to be resected. The purpose of injecting fluids into the submucosa was to increase the distance between the base of the polyp and the serosa and thus safely eliminate lesions by cutting on the large cushion produced in the submucosa (33,35). In order to proceed with the polypectomy, the polyp had to be located between 5 o'clock and 7 o'clock as traditionally recommended (31). To achieve this location we used various maneuvers such as applying torque to rotate the colonoscope, changing the patient's position from right lateral decubitus to left supine, correction of the colonoscope, and use of gastroscopes. Sessile polyps were defined as those whose heights were greater than 2.5 mm. Flat polyps were defined as those whose heights were less than 2.5 mm (6). Standard, oval or hexagonal Olympus polypectomy snares were used with snare size being chosen according to the polyp size (10, 31). After achieving adequate polyp lift, the opened snare was placed around the polyp and the proximal part was pressed and progressively closed until it could satisfactorily embrace the polyp (3, 11, 31). For pedunculated polyps the saline solution was injected into the base of the pedicle which was then embraced by the snare. Initially pressure was applied to the proximal portion, but once the polyp had been grabbed, the snare was used to progressively squeeze the polyp until cyanosis appeared on the polyp head. At that point coagulation was applied. The cut was performed at least 5 mm below the bottom of the polyp head to leave a safe margin of healthy tissue in the event that malignant polyps were found in the histological examination. This ensured a margin of at least 3 mm free of tumor invasion which is the standard healing criteria when there is a malignant polyp (32). After resection sufficient air was blown on to the resection site to view it and verify that there were no complications such as bleeding or perforation, and to verify that no residual polypoid tissue

remained. Any remaining residual tissue found was removed in a fashion similar to that which has been described. Polyps greater than or equal to two cm were removed piecemeal until complete resection was achieved and the muscularis mucosa or the muscularis itself could be properly viewed (3, 16, 33). We always tried to completely resect the lesion in a single block, but when this was not possible piecemeal resection was used with an injection of saline solution prior to each cut as previously described. As residual segments got smaller, smaller snares were chosen. In each instance we always included at least 1mm to 3 mm from the normal mucosa to ensure complete resection of the lesion without leaving any residual tissue.

A PSD-30 OLYMPUS electro-surgical unit was used with pure coagulation current set at 35 W power. In cases where it was difficult to cut large chunks or thick pedicles we changed to pure cut with the same power. Finally, after the polyp had been resected (whether in one block or piecemeal) it was recovered with the snare, a polyp basket or with steady suction attaching the specimen to the tip of the colonoscope. Once recovered the specimen was sent to pathology where it was immersed way in buffered formaldehyde in the usual for histopathological analysis. All procedures were performed on an outpatient basis. Patients were hospitalized only if there were any complications that could not be uncontrolled endoscopically.

Complications

Bleeding was classified into according to time of occurrence: *during procedure* when the polypectomy was being performed, *early* when it occurred within 24 hours after the procedure, and *late* when it occurred more than 24 hours after the procedure. Diagnoses of early and late complications were based on excretion of fresh blood from the rectum. Treatment of bleeding treatment in all three scenarios consisted of injecting adrenaline diluted 1:20,000 in a saline solution around the polypectomy site and/or placing Olympus hemoclips (3, 16, 33). In our service we do not have argon plasma, multipolar coagulation or heater probes. Postpolypectomy syndrome which is produced by thermal lesion of the peritoneum was diagnosed based on abdominal pain, fever and leukocytosis. The diagnosis of perforation was based on direct observation of the discontinuity with visualization of the abdominal cavity during the procedure or by the demonstration of pneumoperitoneum on a plain abdominal x-ray or CT scan.

Exclusion criteria

Polyps suggestive of cancer that were excluded (16) included those which did not rise when the submucosa was injec-

ted, ulcerated polyps, polyps that felt hard when probed with biopsy forceps, those with any marked deformity in the folds, and extremely friable giant polyps. Patients with any of these indications were referred to coloproctology for surgical resection. We excluded some polyps because of their location when they could not be properly placed in position for resection, and we also excluded polyps that occupied more than a third of the circumference of the colon or more than two austral contiguous folds (33, 34). Since resection of polyps of this size by mucosectomy implies greater risk of perforation and stenosis, the preferred techniques in these cases are ESD and surgery.

Follow-up

In cases of adenomatous polyps colonoscopic follow-up examinations were performed every three years, but in cases of malignant polyps colonoscopic follow-up examinations were performed every three months. When polyps were located outside of the rectum or the cecum the healthy mucosa near the location of the polypectomy was marked with Chinese ink according to previously described protocols (16, 31). During follow-up any polyps found were resected at a later appointment. When the resection location was identified, scar biopsies were taken.

Variables evaluated

Variables evaluated included age; gender; size, shape and location of polyps; adequate or inadequate lifting of lesions with submucosal injection; complications including bleeding, perforation and postpolypectomy syndrome; histology including whether adenomas were tubular or villous, grade of dysplasia and cancer; whether *in toto* or piecemeal resection technique was used; and hemostasis technique in cases of bleeding.

Statistical analysis

Continuous data are described by means, standard deviations and ranges according to the distribution. Categorical variables were presented as numbers and percentages. Measures of association were determined using odds ratio. All data were processed using the PAWS statistical package 18 version 18.8 (SPSS - IBM).

RESULTS

420 patients had 548 polyps resected from January 2003 to September 2011. Polyps sizes ranged between 10mm and 130mm. Demographic characteristics of patients are shown in Table 1. The 130 mm polyp had an implantation base

approximately 3 cm high. Its size was discovered through piecemeal resection. Despite its size it did not compromise more than a third of the circumference of the colon or more than two austral folds which were both exclusion criteria.

Average patient age was 56.3 years with a 13.1 SD and a range of 14 to 93 years (Figure 1). 201 cases were male and 219 were female. The most common location of polyps was the left colon where 67.4% of the polyps (283) were found (Table 2). The average polyp size was 1.6 cm.

Table 1. General information about resected lesions.

Number of patients	420
Average Age and Range	56.3; SD 13.1; Range: 14-93
Gender (M/F) (%)	201/219; (47.9/52.1)
Number of polyps	548
Average Polyp Size (cm) and Range	1.6 cm; SD 12.2 ; Range 1.0 to 13 cm
Shapes	
Pedunculated	352 (83.8%)
Sessile	56 (13.3%)
Flat	12 (2.85%)
Location (%)	
Sigmoid	116 (27.6)
Rectum	97(23.1)
Descendant	70 (16.7)
Transverse	20 (4.8)
Ascendant	15 (3.6)
Cecum	4 (1)
Various locations	98 (26.4)

SD: Standard Deviation

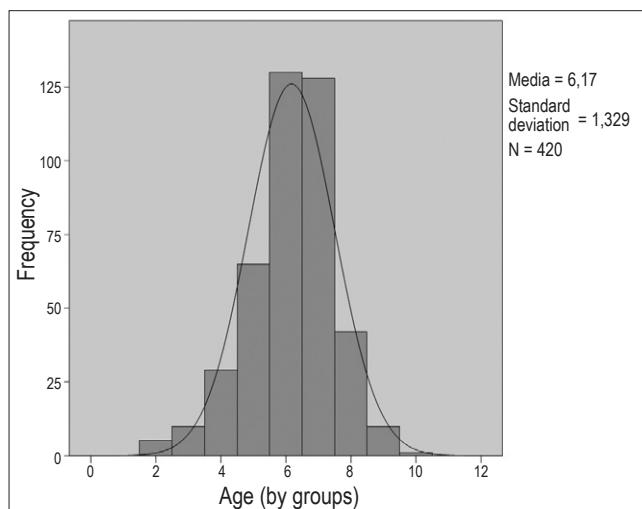


Figure 1. Age distribution by groups (life decades).

All resected polyps were raised with submucosal injections. Except for two polyps, all procedures were performed in a single session. The two exceptions were each completed

in one additional session. Fifty five of these polypectomies were piecemeal. In these cases additional saline injections were given in a manner similar to that at the beginning of the procedure, and it was necessary to repeatedly flush the resection location in order to maintain proper visualization of remaining polyp segments and achieve complete resection of these without any complications. Whenever necessary, the area was vacuumed to shrink the mucosa and allow it to be grabbed by the snare. The smaller the residual fragments were, the smaller were the snares used.

Table 2. Polyp Characteristics.

Number of Polyps	548
Size (cm)	1.6 cm DS 12.2 (1.0- 13 cm)
Shapes	
Pedunculated	352 (83.8%)
Sessile	56 (13.3%)
Flat	12 (2.85%)
Complications (%)	
Intraoperative bleeding	36 (8.6)
Perforation	0
Postpolypectomy syndrome	0
Hemostatic techniques	
Endoscopic Injection	36 (100)
Endoclip	8 (22%)
Histological type (%)	
Tubular adenoma	180 (43)
Tubulovillous adenoma	96 (23)
Villous adenoma	79 (19)
High grade dysplasia adenoma	130 (31)
Malignant polyp	21 (5)
Intramucosal cancer	5 (1.2)

83.8% of polyps were pedunculated, 13.3% were sessile and 2.85% were flat. The only complications which occurred were 36 cases of intraoperative bleeding (8.6%). These were satisfactorily resolved by endoscopic hemostasis with injections of epinephrine diluted 1:20,000 in normal saline solution. Eight of these cases also required placement of endoclips for complementary control of bleeding. Bleeding occurred in 7 polyps with sizes larger than 15 mm and thick pedicles, in 5 piecemeal resection cases, in 7 cases of flat polyps larger than 20 mm and in 17 cases of juvenile polyps smaller than 15 mm. Five of these were associated with the injection site rather than with resection by snare. No cases required hospitalization or transfusions. There were no cases of perforations or postpolypectomy syndrome. The OR for complications according to polyp size (less than or equal to 20 mm versus greater than 20 mm) was 0.44 with a 95% CI of 0.19 to 1.01. According to the number of resected polyps we found a 1.44 OR and a 95% CI of 0.65-3.20, independent of whether one or more polyps were resected. Histology showed tubular adenomas were

most common (43%) followed by tubulovillous adenomas (23%) and villous adenomas (19%). High-grade dysplasia was present in 31% of cases including 21 cases of malignant polyps and 5 cases of intramucosal carcinoma. Polyp sizes of 20 mm or larger were associated with cases of intramucosal carcinoma and malignant polyps which met the healing criteria (32.) Four cases of sessile polyps in the transverse colon had difficult approaches because they were hidden behind folds. Resections were achieved by using a gastroscope and a retrovision maneuver. One of these polyps measured approximately 25 mm and was successfully resected with multiple cuts. Follow-up has been complete in all patients but is still underway. All patients with polyps larger than 20 mm had colonoscopic follow-ups within three months of the initial resection as recommended in the "Polyp Treatment Guide" of the American Association of Gastrointestinal Endoscopy (ASGE) (32). During follow-up residual polyps were found in two patients who had undergone piecemeal polypectomies. These were completely resected without complications at sessions three months after the original procedure.

DISCUSSION

This is probably one of the largest series studied in Latin America. It has demonstrated the effectiveness and safety of the inject and cut technique for resection of more than 500 colon polyps. 59 of these were more than 20 mm across and one measured 130 mm. 45 of these polyps were flat or sessile and had to be resected piecemeal.

The results of this work, particularly the 8.6% complication rate consisting entirely of minor controlled intraoperative bleeding, demonstrate the safety of this procedure in our country as well as the skill that has been attained in its practice. Frequency of bleeding as a complication is within the range of 0.85% to 24% found in international publication (35). Although it has been considered traditionally that immediate bleeding is most likely related to the use of a pure cut, (36) in this study no immediate bleeding occurred in any of the six cases in which there was a change from coagulation to pure cut. In the 45 cases of piecemeal resection bleeding occurred in 5 cases (9%) which is less than the 24% that has been reported internationally (37). Contrary to what has been published regarding the lower rate of bleeding in smaller polyps, this study found no such association. The OR for bleeding polyps smaller than 20 mm vs. greater than this size was 0.44 (95% CI 0.19- 1.01). There were no perforations in any cases, although perforations are considered to be the second most important complication after bleeding and are the main predictor of mortality (38). In the Ferrara et al. series (25), perforation occurred in two cases (1.1%).

In addition to the skills acquired, we consider that a key point is refinement of the technique which saves health care costs since this is a safe and effective technique in most cases and therefore reduces economic costs required for management of complications. It is also an easy-to-use method. The use of endoclips or hemoclips has made a significant contribution to controlling postpolypectomy bleeding. Although for various reasons they are not clearly indicated for prophylaxis of bleeding, it has been shown that their use decreases postpolypectomy bleeding and helps control minor perforations (39, 40). While the literature has described the use of prophylactic methods to prevent bleeding (39, 40), this series did not use them because this complication was not important. Therefore, leaving aside for the moment the issue of the expertise gained from methods that work, it is fundamental that we take into account that it is not necessary to follow all the recommendations of the literature since they can increase costs. In this series we did not use prophylactic methods other than submucosal injection to stop bleeding. In this light it should be noted that it has been reported that bleeding may occur at the site prior to ligation with the use of the endoloop which is recommended by many experts as a prophylactic method to prevent bleeding (15, 41,42).

Although the literature currently makes strong recommendations that performance of polypectomies to treat polyps larger than 2 cm across should be done through endoscopic submucosal dissection, we consider that the inject and cut technique is an alternative that requires less advanced training and less resources. This technique has shown that, if performed properly by cutting larger fragments rather than several smaller fragments, it can accomplish comparable success rates for most cases (25). Nevertheless, ESD is currently indicated for large polyps located in the rectum and rectosigmoid where the colon wall is thicker and can tolerate the demands of the procedure. ESD is contraindicated for proximal colon polyps or in angled positions (35). The OR for complications according to polyp size and number of resected polyps showed no statistically significant results, although in larger series of polyps larger than 20 mm and multiple polypectomies there is an increased risk of complications, even if it is still low (25). The excellent results presented in this present study, both in terms of effectiveness of polyps eradication and in terms of the rate of low complications, match those of Ferrara et al. (25) who used a similar methodology in a series of more than 150 polyps larger than 15 mm. It is also similar to another recently published Brazilian study which used this technique in 172 colonic polyps larger than 20 mm (43). In these two studies (25, 43) the bleeding rates were 2.8% and 2.9% respectively although the series were both smaller lower than that in the present

study. The importance of the effectiveness and safety of this technique in a series of more than 500 resected polyps is demonstrated if we take into account that 27% to 31% of colon cancers detected after a colonoscopy occur as the result of incomplete or ineffective polypectomies (44, 45). There were no such cases in this investigation. During follow-up the two cases with polyps that remained after the initial polypectomy were completely resected. Follow-up, which has now gone on continuously for more than three years, and which included all patients, has not found cancer in any of these patients. These results allow us to say that with the protocol used, including a security cushion that raises the mucosa and the use of a snare to cut at least three mm below the lesion to include healthy mucosa, we have achieved the goal of every colon polypectomy of stopping the adenoma-cancer sequence.

CONCLUSIONS

1. This study represents the largest series of colon polypectomies ever studied in our country.
2. It has been demonstrated that the inject and cut polypectomy technique is practical and effective with low risk of complications and without local recurrences of the polyp or the tumor.
3. Because of its simplicity, low cost and effectiveness it is recommended that this procedure be used in strict accordance with its protocol. It should be correctly taught to gastroenterology residents and practicing gastroenterologists who do not perform this technique yet should be encouraged to learn it and use it.
4. With the results obtained including in the follow-up, it has been demonstrated that use of this method can change the statistics related to reports that, "colon cancers after a colonoscopy are due to incomplete or ineffective polypectomies."

Funding

The costs of this work were entirely assumed by the authors.

REFERENCES

1. Bond JH. Colon polyps and cancer. *Endoscopy* 2003; 35: 27-35.
2. Winawer SJ, Zauber AG, Ho MN, et al. Prevention of colorectal cancer by colonoscopic polypectomy: the National Polyp Study Workgroup. *N Engl J Med* 1993; 329: 1977-1981.
3. Poppers D, Haber GB. Endoscopic Mucosal Resection of colonic lesions: current applications and future prospects. *Med Clin N Am* 2008; 92: 687-705.

4. ASGE. Endoscopic mucosal resection and endoscopic submucosal dissection. *Gastrintest Endosc* 2008; 68: 11-18.
5. Rubin PH, Waye JD. Colonoscopic polypectomy: A critical review of recent literature. *Curr Gastroenterol Rep* 2006; 8: 430-33.
6. The Paris endoscopic classification of superficial neoplastic lesions: esophagus, stomach, and colon. *Gastrointest Endosc* 2003; 58 (Suppl. 6):S2-S43.
7. Ohkuwa M, Hosokawa K, Boku N, et al. New endoscopic treatment for intramucosal gastric tumors using an insulated-tip diathermic knife. *Endoscopy* 2001; 33: 221-6.
8. Tanaka A, Oka S, Kaneko I, et al. Endoscopic submucosal dissection for colorectal neoplasia: possibility of standardization. *Gastrointest Endosc* 2007; 66: 100-7.
9. Fujishiro M, Yahagi N, Nakamura M, et al. Endoscopic submucosal dissection for rectal epithelial neoplasia. *Endoscopy* 2006; 38: 493-7.
10. Onozato Y, Kakizaki S, Ishihara H, et al. Endoscopic submucosal dissection for rectal tumors. *Endoscopy* 2007; 39: 423-7.
11. Karghi A, Waxman I. State of the art on endoscopic mucosal resection and endoscopic submucosal dissection. *Gastrointest Endosc Clin North Am* 2007; 17: 441-69.
12. Repicci A, Pellicano R, Strangio G, Danese S, Fagoonee S, Malesci A. Endoscopic mucosal resection for early colorectal neoplasia: pathologic basis, procedures, and outcomes. *Dis Colon Rectum* 2009; 52: 1502-15.
13. Kedia P, Waye JD. Routine and advanced polypectomy techniques. *Curr Gastroenterol Rep* 2003; 13: 506-11.
14. Fyock CJ, Draganov PV. Colonoscopic polypectomy and associated techniques. *World J Gastroenterol* 2010; 16: 3630-7.
15. Gallegos-Orozco JF, Gurudu SR. Complex colon polypectomy. *Gastroenterol Hepatol (NY)* 2010; 6: 375-82.
16. Saunders B. How I do it? OMED 2010. (www.OMED.org)
17. Kantsevoy SV, Adler DG, Conway JD, Diehl DL, Farraye FA, Kwon R, et al. Endoscopic mucosal resection and endoscopic submucosal dissection. *Gastrointest Endosc* 2008; 68: 11-8.
18. Saito Y, Fukuzawa M, Matsuda T, Fukunaga S, Sakamoto T, Uraoka T, et al. Clinical outcome of endoscopic submucosal dissection versus endoscopic mucosal resection of large colorectal tumors as determined by curative resection. *Surg Endosc* 2010; 24: 343-52.
19. Kato H, Haga S, Endo S, Hashimoto M, Katsume T, Oi I, et al. Lifting of lesions during endoscopic mucosal resection (EMR) of early colorectal cancer: implications for the assessment of resectability. *Endoscopy* 2001; 33: 568-73.
20. Tanaka S, Haruma K, Oka S, Takahashi R, Kunihiro M, Kitadai Y, et al. Clinicopathologic features and endoscopic treatment of superficially spreading colorectal neoplasms larger than 20 mm. *Gastrointest Endosc* 2001; 54: 62-6.
21. Bujanda L, Cosme A, Gil J, Arenas-Mirave JI. Malignant colorectal polyps. *World J Gastroenterol* 2010; 16(25): 3103-11.
22. Tolliver KA, Rex DK. Colonoscopic polypectomy. *Gastroenterol Clin North Am* 2008; 37: 229-51.
23. Stolte M. The new Vienna classification of epithelial neoplasia of the gastrointestinal tract: advantages and disadvantages. *Virchows Arch* 2003; 442: 99-106.
24. Morris ML, Tucker RD, Baron TH, Song LM. Electrosurgery in gastrointestinal endoscopy: principles to practice. *Am J Gastroenterol* 2009; 104: 1563-74.
25. Ferrara F, Luigiano C, Ghersi S, Fabbri C, Bassi M, Landi P, et al. Efficacy, safety and outcomes of 'inject and cut' endoscopic mucosal resection for large sessile and flat colorectal polyps. *Digestion* 2010; 82: 213-20.
26. Deyhle P, Largiander F, Jenny S, Fumagalli I. A method for endoscopic electroresection of sessile colorectal polyps. *Endoscopy* 1973; 5: 38-40.
27. Chandrasekhara V, Ginsberg GG. Endoscopic mucosal resection: not your father's polypectomy anymore. *Gastroenterology* 2011; 141-9.
28. <http://globocan.iarc.fr/>.
29. Regula J, Rupinski M, Krazewska E, et al. Colonoscopy colorectal -cancer screening for detection of advanced neoplasia. *N Engl J Med* 2006; 355: 1863-72.
30. Lieberman D, Moravec M, Holub J, et al. Polyp size and advanced histology undergoing colonoscopy screening: implications for CT colonography. *Gastroenterology* 2008; 135: 1100-1105.
31. Waye J. Techniques for polypectomy and the problem polyp. *Techn Gastrointest Endosc* 2003; 5: 160-5.
32. Bond JH. Polyp guideline: diagnosis, Treatment and surveillance for patients with colorectal polyps. *Am J Gastroenterol* 2000; 95: 2053-63.
33. Waye JD. Advanced polypectomy. *Gastrintest Endosc Clin North Am* 2005; 15: 733-56.
34. Seitz U, Bohanacker S, Seewald S, Thonke F, et al. Difficult polypectomy. In Waye JD, Rex DK, Williams CB, eds. *Colonoscopy principles and practice*. Malden Mass: Blackwell Publ inc.; 2003. p. 420-42.
35. Mönkemüller K, Neumann H, Malfertheiner P, Fry LC. Advanced colon Polypectomy. *Clin Gastroenterol Hepatol* 2009; 7: 641-52.
36. Parra-Blanco A, Kaminaga N, Kojima T, et al. Colonoscopic polypectomy with cutting current: is it safe?. *Gastrointest Endosc* 2000; 51: 676-81.
37. Nelson D, Block D, Bosco J, et al. ASGE technology status evaluation report: endoscopic mucosal resection. *Gastrintest Endosc* 2000; 52: 860-63.
38. Consolo P, Luigiano C, Strangio G, Scaffidi MG, Giacobbe G, Di Giuseppe G, et al. Efficacy, risk factors and complications of endoscopic polypectomy: ten year experience at a single center. *World J Gastroenterol* 2008; 14: 2364-9.
39. Li LY, Liu QS, Li L, Cao YJ, Yuan Q, Liang SW, et al. A meta-analysis and systematic review of prophylactic endoscopic treatments for postpolypectomy bleeding. *Int J Colorectal Dis* 2011; 26: 709-19.
40. Kouklakis G, Mpoumparais A, Gatopoulou A, Efraimidou E, Manolas K, Lirantzopoulos N. Endoscopic resection of

large pedunculated colonic polyps and risk of postpolypectomy bleeding with adrenaline injection versus endoloop and hemoclip: a prospective, randomized study. *Surg Endosc* 2009; 23: 2732-7.

41. Umino J, Watanabe Y, Hayashida N, et al. Hemorrhage after EndoloopR assisted colon polypectomy: A case report. *Endoscopy* 1999; 55: 98-9.
42. Mitui T, Komatsu H, Nabeshima Y, et al. Heavy bleeding after Endoloop assisted gastric polypectomy: a case report. *Hiroshima Igaku* 2002; 55: 818-20.
43. Oliveira Dos santos CE, Malaman D, Pereira-Lima JC. Endoscopic mucosal resection in colorectal lesiÓN:a safe and effective procedure even in lesions larger than 2 cm and in carcinomas. *Arq Gastroenterol* 2011; 48: 242-7.
44. Pabby A, Schoen RE, Weissfeld JL, et al. Analysis of colorectal cancer occurrence during surveillance colonoscopy in the dietary Polyp Prevention Trial. *Gastrointest Endosc* 2005; 61: 385-91.
45. Farrar WD, Sawhney MS, Nelson DB, et al. Colorectal cancers found after a complete colonoscopy. *Clin Gastroenterol Hepatol* 2006; 4: 1259-64.